A PHYSICAL ASSESSMENT OF COMPOSITION AND RATIO OF CONTENTS IN MUNICIPAL SOLID WASTE IN Kolkata Municipal Corporation Area

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Background

As estimated, around 4000 MT of municipal waste is generated in Kolkata Municipal Corporation Area. Disposal of this waste, everyday, is a serious challenge for the municipal authority. Very little amount of this waste is processed. Waste pickers collect a little amount of recyclable waste from the disposed of mixed waste at the street sides, intermediate dump sites and Dhapa dumping site. Considerable portion of the recyclable waste gets devalued due to mixed and dirty condition and go into the landfill. Simultaneously all the wet wastes go into the landfill. A minute fraction of this waste is said to be composted in the composting plant in the dump site but almost all the waste finds its place in the ever expanding dumpsite encroaching the precious wetland of East Kolkata.

Solid Waste Management Rules 2016 directs that introduction of **source segregation of waste** in every municipal and even semi-urban area and **processing** of segregated waste are **compulsory**. Any kind of processing, be it composting or recycling or bio-methanation or incineration or gasification or pyrolysis needs source segregation, so that every component in the waste is identified and finds its proper destination at the processing stage. Identification of the components in waste with respect to their final processing is imperative. Number of studies has been conducted to identify such components in many cities at different occasions. But the composition of waste, both in terms of items and ratio, is changing rapidly. Rapid urbanization, invention of technologies, changing pattern of consumption and more interestingly developing techniques of waste processing are generating need for further studies.

Objective

Several studies have been conducted on different occasions to estimate physical and chemical composition of waste for various purposes. It has been observed that the pattern of waste generation had been changing. One major change is the increasing proportion of disposable plastic products in the waste stream. Plastic carry bags are mostly targeted as reference point. But the quantity of waste containing plastic cups is also increasing considerably. These wastes, if collected together in cleaner condition, may be sent to recycling units. Scattered waste of this kind does not attract the waste pickers or collectors. Another concern is the multilayered soft packagings like satches of gutkha, pan masala, potato chips etc. They are not generally recycled. Only in some cases they may be used as low quality end product like lump formation in street dividers. As the quantity of such product is increasing, assessment of generation is needed. There are other kind of plastic products like thermocol, polystyrene etc. which

cannot be recycled or reused at all. So these are to be considered as inert and assessment of generation of such waste was to be taken up.

There is growing concern on informal recycling of e-waste. Discards after dismantling and recycling of e-waste and direct mixing of some components in municipal waste may be highly polluting. Earlier studies did not take up this item because the issue was not so highlighted. Now a need has been felt to assess the proportion of such waste coming into municipal waste stream.

SWM Rules 2016 provides direction for introduction of separate collection of sanitary waste (used diapers, sanitary pads etc.) so that those may be treated separately. These have been termed as "domestic hazardous" waste. So an assessment of generation of the same was felt necessary.

Keeping all these in consideration, the present study has been conducted to assess the physical composition of municipal waste and its proportion in Kolkata Municipal Area, to facilitate developing a management system which will comply with Solid Waste Management Rules, 2016. It is to be noted that though assessment of chemical composition of waste is also very important and several samples were collected during survey for the purpose, this report will confine in analyzing the physical composition only. The study also does not attempt to assess the amount of waste generation in Kolkata or even in an area. This will deal only with proportion of various components in the waste.

Literature Survey

In 1970, NEERI (the then CPHEERI) conducted an extensive survey to assess the generation of waste in KMC area and alternative method of disposal. The Institute analyzed a large samples (154 sampling points/collection vats) all over the city. The basic findings showed the following – Biodegradable – 41%, Recyclable - 13%, Coconut shells – 5% and Inert waste 40%.

In 1985 AIIH&PH carried out a study on solid waste with special reference to socio-economic aspects of recycling through scavenging. Samples were collected from markets, community containers and primary collection points. The percentage of compostable components in community bins and primary collection was found to be abnormally low (19.33%). However, the compostable portion of waste in market was 70.64% which was normal. In case of inert such as brick, earthenware, ash, loose earth, sand, silt the same was found to be very high in community bin & primary collection

points as 81.25% & 66.41% respectively. However, in case of market this component was 20.51% which is normal.

In May-June, 1993 CMDA also carried out study through the agency of AIIH&PH for characterization of solid waste. Samples were collected from Market, Residential and Residential & Commercial mixed area. The results indicate presence of 34.80% of biodegradable, 11.95% of recyclable, 6.20% of coconut shell and 46.95 of inert waste.

In the year 1995 NEERI again carried out another extensive study on waste characterization. NEERI collected 267 samples on an average 2 each from 141 wards during Monsoon, 282 samples during winter and summer from the collection points (2 samples per each of the 141 wards). The results were shown separately for point sources and market waste

Municipal Solid Waste from Point Source					
Sl No.	**Ingredients**	**Monsoon**	**Winter**	**Summer**	**Average**
1	Biodegradable	39.65	45.46	47.84	**43.3**
2	Green Coconut Shell	4.61	9.57	11.36	**8.51**
3	Paper	6.10	3.94	3.87	**4.45**
4	Plastics	4.06	3.33	2.27	**3.22**
5	Glass and Crockery	1.33	2.16	1.68	**1.72**
6	Metals	0.42	0.45	0.44	**0.43**
7	Coal	2.50	3.23	3.27	**3.0**
8	Inert	35.0	26.90	18.57	**26.8**
9	Others(Bio-resistant)	6.42	4.96	10.70	**7.36**
Municipal Solid Waste from Market					
1	Biodegradable	78.83	65.40	72.72	**72.3**
2	Paper	2.16	1.73	1.30	**1.73**

3	Plastics	0.66	0.62	0.57	**0.61**
4	Glass and Crockery	0.20	0.04	0.04	**0.10**
5	Bioresistant	3.42	2.66	0.74	**2.27**
6	Inert	14.31	29.34	24.79	**22.8**

Table 1

In January 2000 a study was conducted for KEIP which showed 58% biodegradable, 23% recyclable and 19% inorganic (inert) composition in waste.

Another important study for KEIP was conducted to develop SWM plan in 2005. The project collected samples from residential, commercial, market, industrial and institutional areas. Even in case of residential areas it considered variations from areas of low, middle and high income groups. Any average composition of all the waste was not derived in this study. In case of residential areas, the results shown for domestic municipal solid waste samples as 45.09% is comprised of fruits and vegetable wastes of total MSW followed by 8.84% paper. The study compared its findings with some other previous studies. But it did not mention about the proportion of inert waste. However the study gave more importance to chemical analysis of the waste. As the present study deals only physical composition of waste, we are not going into any further discussion on the referred study.

A study on Status of Municipal Solid Waste Management prepared in 2010 for the West Bengal Pollution Control Board conducted survey in 5 municipalities, namely Bidhannagar, Titagarh, Chandannagar, Kharagpur and Rajigunj. Average result of physical sampling showed 48% of biodegradable including leaves, 29.06% of inert including earthenware, 6.07% of coconut shell, recyclable 16.69%.

Methodology

The present study was taken up with the support of GKW for Kolkata Environment Improvement Investment Project. Due to time constraint, sample size was relatively smaller. Sampling was conducted at 25 points. The exercise was facilitated by related ward offices of Kolkata Municipal Corporation. Sampling was conducted during spring of 2017. The sampling covered mostly residential areas (both common and slum areas). Samples from a few commercial and market areas were also taken. Sampling also took

place in two large hospitals to assess the amount of bio-medical waste getting mixed up in municipal waste. Following was the schedule –

Waste Sampling - Work Schedule					
Date	**Market Area**	**Residential Area**	**Commercial Area**	**Hospital**	**Dump Site**
9.3.17			Shyambazaar		
10.3.17		Entally	Park Street, Chandni Chowk		
11.3.17		Mathpukur (Slum)			Dhapa Dumping Ground
14.3.17		Bhowanipur, Kalighat, Rasbehari			
15.3.17	Gariahat	Ballygunj,			
16.3.17		Behala, Parnasree			
17.3.17			Camac Street		
18.3.17		Khiddirpore			
21.3.17		Park Circus		P G Hospital	
22.3.17		Tollygunj		Bangur Hospital	
23.3.17	Hati Bagan Market	Bagbazar			
25.3.17	Tangra	Topsia (Slum)			
26.3.17	Sealdah Market		Sealdah Court		
	4	13	5	2	1

Table 2

In each case, except Dhapa dumping ground, sampling was conducted at the intermediate stations where corporation workers bring the waste after collection from door to door for uploading in compactors or trucks for onward transmission. More or less 500 Kg of waste was taken for assessment.

At each point two or three hand carts / rickshaw carts were off loaded. Biodegradable waste was kept as a whole at one side. All other contents were manually segregated according to their categories and then filled in separate plastic bags. These bags were weighed with perfectly calibrated digital weigh machine. Volume of the samples was measured with measuring tapes keeping the waste in carts and assessing the length and breadth of the carts and height of the content.

Findings

Average generation of various categories of waste received in 24 samples collected from intermediate stations (excluding Dhapa dumping ground) and their proportion may be ascertained from Table 3 –

Items	Total Wt.	Average	%
Compostables - Food Waste (raw and cooked), garden waste, leaves and meat	8418.330	350.763	65.76
Paper - Newspaper, Books and Magazines	320.675	13.361	2.50
Card Board - Hard packaging materials	329.145	13.714	2.57
Tetra Packs - Milk Cartons, juice packets	28.743	1.197	0.22
Dense Plastic - HDPE, Crockery,	67.253	2.802	0.53
PET Bottles and PET Items	52.608	2.191	0.41
Light Plastic - poly bags poly cups, serving materials	625.255	26.052	4.88
Multi layered Light Plastic - packaging of gutkha, chips etc.	68.263	2.844	0.53
Polysterene / Thermocol - Food Serving plates, packaging	38.285	1.595	0.30
Coloured Glass -	29.650	1.235	0.23
Transparent Glass -	105.185	4.382	0.82
Ferrous and other metals sticking to magnet and aluminum	21.715	0.904	0.17
Rubber - Tyre and other rubber materials	509.305	21.221	3.98
Leather - shoes, belt, bags etc.	77.575	3.232	0.61
Cloth - textiles, discarded dresses, utilities	316.633	13.193	2.47
Rags - Jute items, packaging materials	40.850	1.702	0.32
Wooden Items - saw dust, wooden chips, broken furniture	85.015	3.542	0.66

Coconut Shells - dry and green	371.075	15.461	2.90
WEEE - All electronic and electronic equipment	8.790	0.366	0.07
Batteries - all kinds of dry cells, lead battery, li-ion batteries	4.200	0.175	0.03
Bio-medical Waste - discarded syringe, needle, equipments found in MSW	21.965	0.915	0.17
Sanitary Napkins, Huggies etc.	90.350	3.764	0.71
Inert Waste - Sand, Ash, earthen material, earthenware	1166.020	48.584	9.11
Discarded Medicine	4.730	0.197	0.04
Total weight of sample (kg)	**12801.613**	**533.400**	**100**
Total Volume of Sample (c.ft)	**957.000**	**39.875**	
Total Volume of Sample (cu.m)	**27.120**	**1.130**	
Density (kg/cu.m)	**472.03**	**472.03**	

Table 3

Proportion of biodegradable comes little more than 65% and recyclable 20.32%. It is to be noted that the proportion of inert waste is considerably low. This may be noted as a changing pattern. Though, apart from the common inert materials like sand, ash earthen ware, silt etc., the items like thrown away wooden chips, coconut shells (which are not reusable), polystyrene and discarded medicines were included in inert waste, the proportion of the same confined to 13% which is much below than the earlier studies. Construction waste does not come to municipal stream.

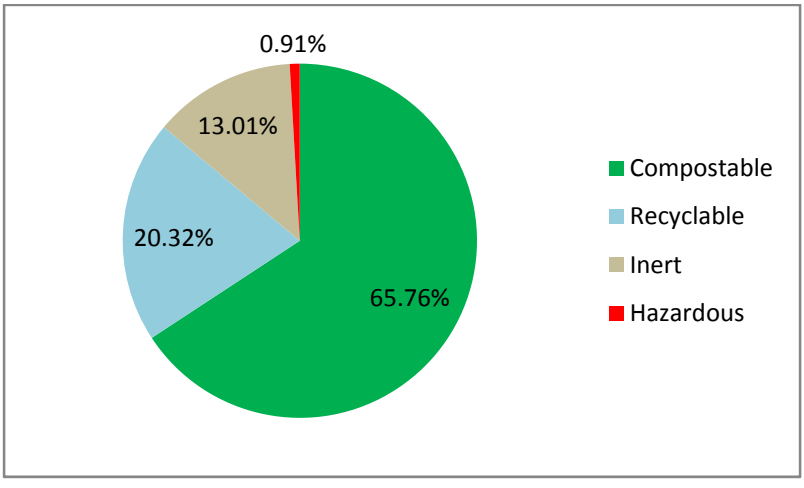

Chart 1 – Average Proportion of Waste of 24 spots

At present there is no open drain in the areas where the survey was conducted. So spills of drain silts have become completely absent in the waste. Earthenware and similar products are not in use in tea shop and sweet shops except in rare cases. So these are not coming at all in the waste stream. Amount of polystyrene have increased but weight of these materials is considerably low.

Proportion of green biodegradable waste is quite high (more than 65%). If these are collected separately and processed in decentralized manner through composting and bio-methenation, proper utilization would be possible. Though this waste contains a good amount of calorific value, the condition is of course wet. As the proportion of this wet waste is high, mixed waste of Kolkata is not suitable for incineration. But scope of energy recovery through anaerobic digestion is very much present.

Due to reduction in proportion of inert waste, proportion of both biodegradable and recyclable materials has increased. As appeared from the sampling exercise, almost 21% recyclable materials are sent to Dhapa dumping ground where only a portion is picked up by waste pickers. Others remain in land fill. An assessment of proportion of various recyclable items shows that a good amount of valuable materials are going to the dump site.

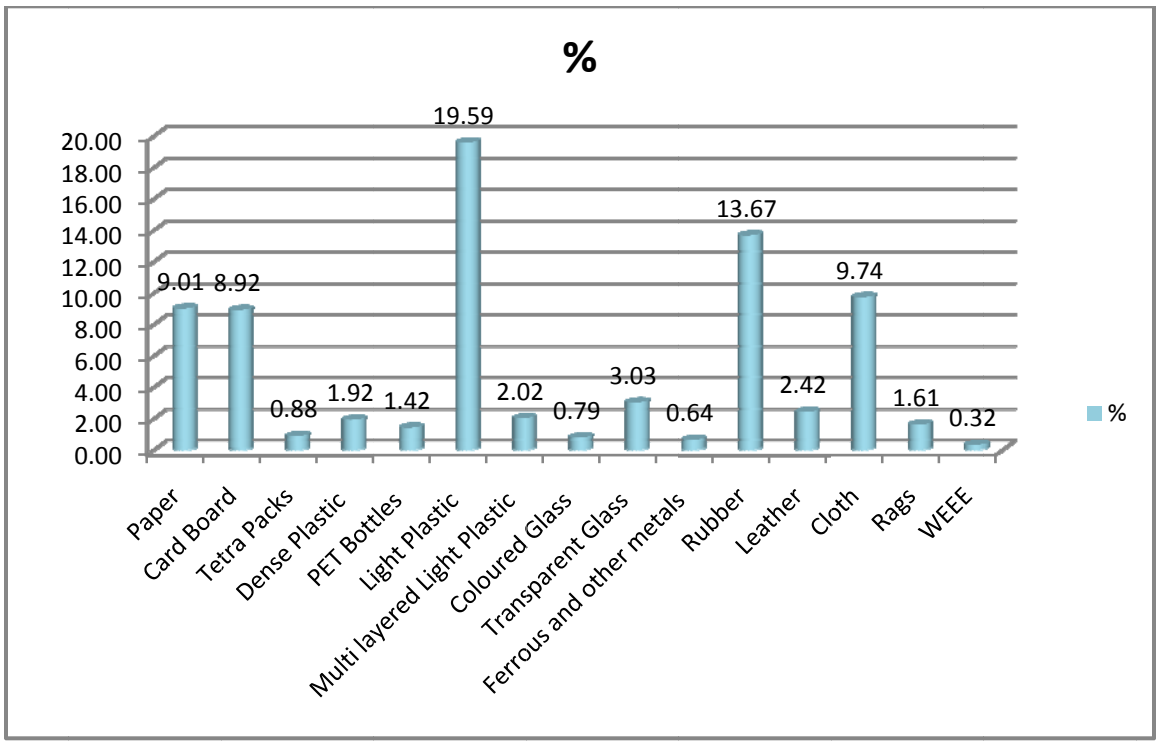

Chart 2 – Proportion of Various Contents in Recyclable Waste

The proportion of recyclable contents shown in **residential waste** is relatively greater (27.18%) than that generated in **commercial areas**. Generation of discards of recyclable waste in commercial areas must be more. But perhaps due to organized diversion to recycling in these areas, the proportion reaches in municipal stream is relatively less (18.30%).

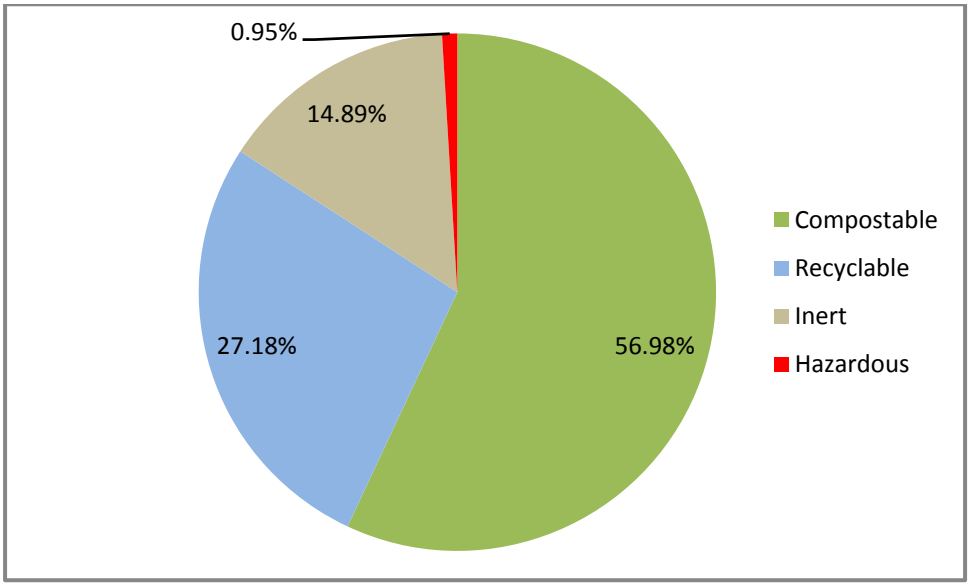

Chart 3 – Proportion in Residential Area

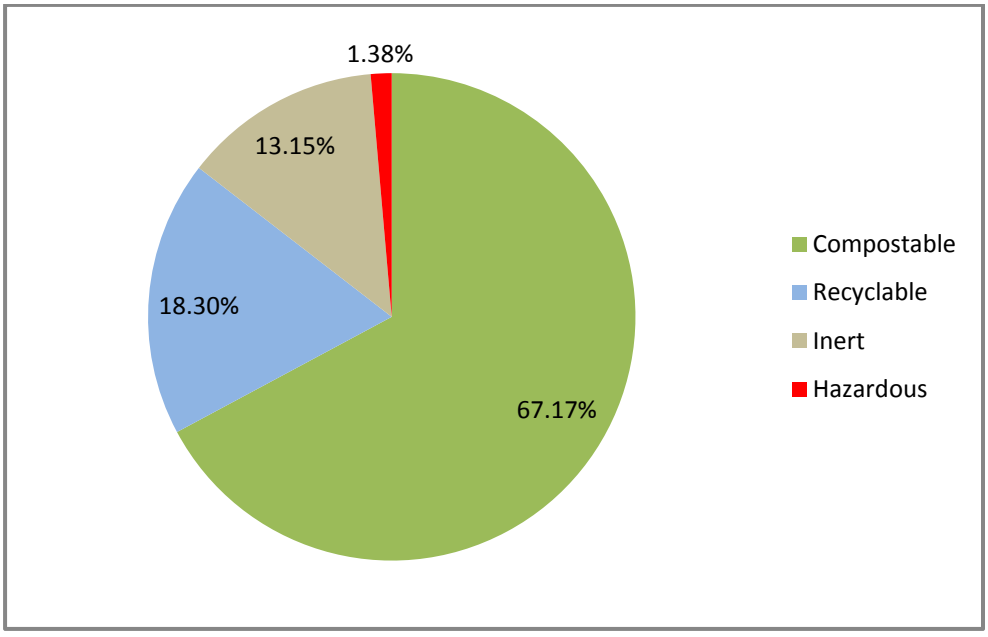

Chart 4 – Proportion in Commercial Area

Market waste as usual contained high proportion of compostable waste as high as 87.09%.

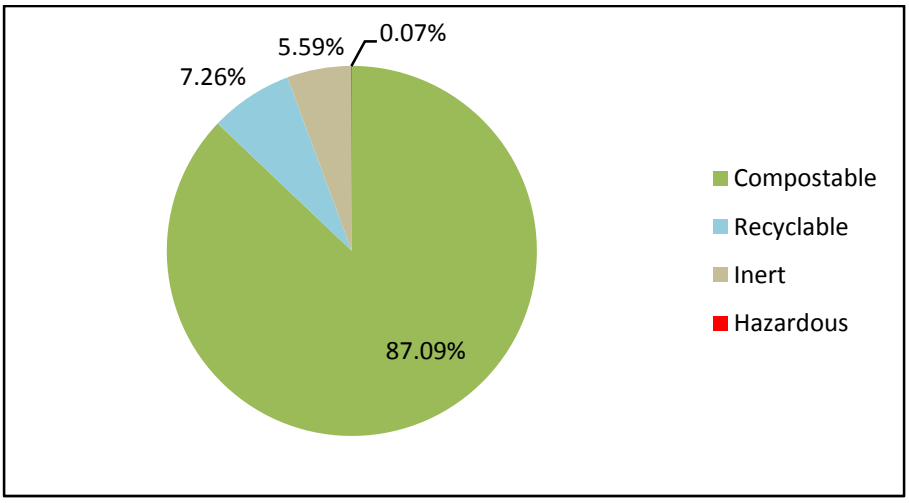

Chart 5 – Proportion in Market Waste

Waste Pattern in Dhapa Dumping Ground

The biodegradable content in waste of Dhapa Dumping Ground has been seen relatively much lower than that of elsewhere. Out of 625.125 Kg of waste sample of Dhapa Dumping Ground, only 287.350 Kg, i.e, 45.96% was found biodegradable wet waste. This might happen due to difficulty in properly random selection of sample due to persisting rains. However the data is presented for record.

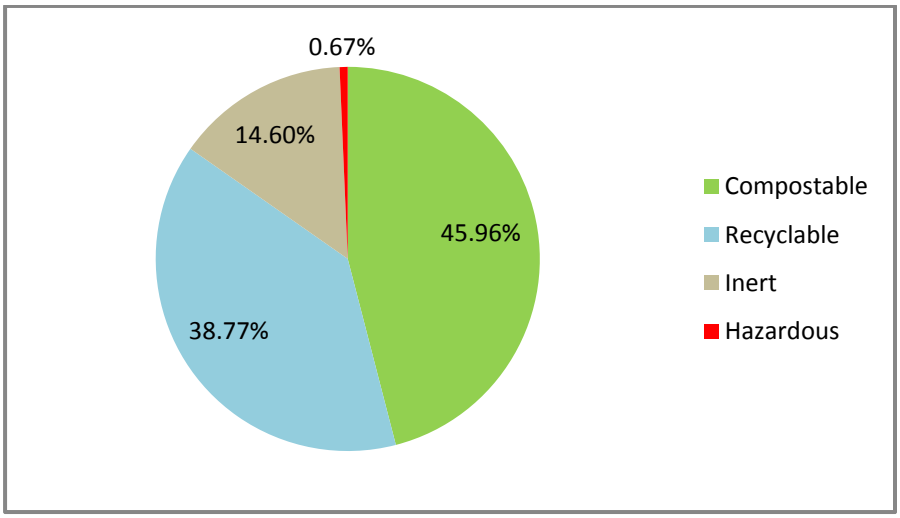

Chart 7

There is concern in disposal of bio-medical waste also. In one spot in Park Street, 14 Kg of bio-medical waste was available in municipal vat. It indicates that some unscrupulous nursing home or pathological centre is mis-routing such waste in spite of availability of regular service of central treatment facility. Even in Bangur Hospital, almost 5 Kg of bio-medical waste was found in municipal vat.

Recommendation

The study reveals that a large amount of recyclable waste is being transported to the dump site at the cost of Municipal Corporation. **MSW Rules 2016** mandates to involve informal waste pickers in waste management so that the dry waste is kept separated at the source and handed over directly to these waste pickers to phase out the practice of waste picking. The new system, if implemented, will stop mixing of waste, devaluation of dry waste, unnecessary carrying of some waste to the dump site (which usually come back to the junk shops in the city) and also facilitate further processing of both dry and wet waste.

Another important aspect is introduction of decentralized processing practices. It is experienced that one common processing centre for a large amount of waste of a city like Kolkata cannot run efficiently and effectively. **MSW Rules 2016** also recommends decentralized processing for effective management of waste. It is advisable that few smaller composting units should be installed at different places of Kolkata. Problem of availability of land also may be reduced if small land is occupied. Transportation cost may also be reduced. Installation of some bio-methenation plants for energy recovery may also be considered.